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National Eutrophication Survey, Corvallis, Oreg

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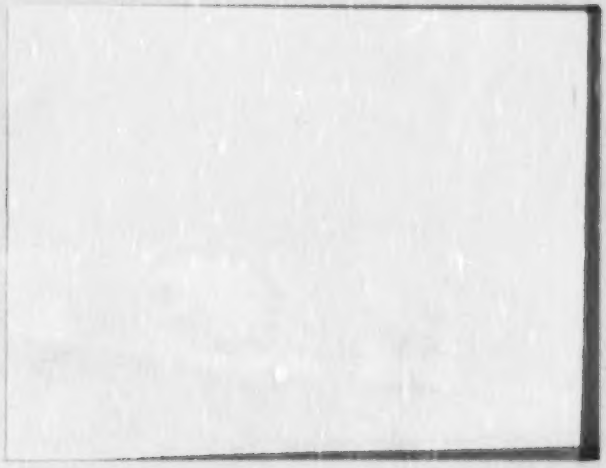
U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES



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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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REPORT
ON
JAMESTOWN RESERVOIR
STUTSMAN COUNTY
NORTH DAKOTA

EPA REGION VIII

WORKING PAPER No. 570

WITH THE COOPERATION OF THE

NORTH DAKOTA STATE DEPARTMENT OF HEALTH

AND THE

NORTH DAKOTA NATIONAL GUARD

OCTOBER, 1976

CONTENTS

	Page
Foreword	ii
List of North Dakota Study Lakes and Reservoirs	iv
Lake and Drainage Area Map	v
Sections	
I. Conclusions	1
II. Lake and Drainage Basin Characteristics	3
III. Lake Water Quality Summary	4
IV. Nutrient Loadings	8
V. Literature Reviewed	12
VI. Appendices	13

FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the North Dakota State Department of Health for professional involvement, to the North Dakota National Guard for conducting the tributary sampling phase of the Survey, and to those North Dakota wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

Norman L. Peterson, Director, and the staff of the Division of Water Supply and Pollution Control of the Department of Health, provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

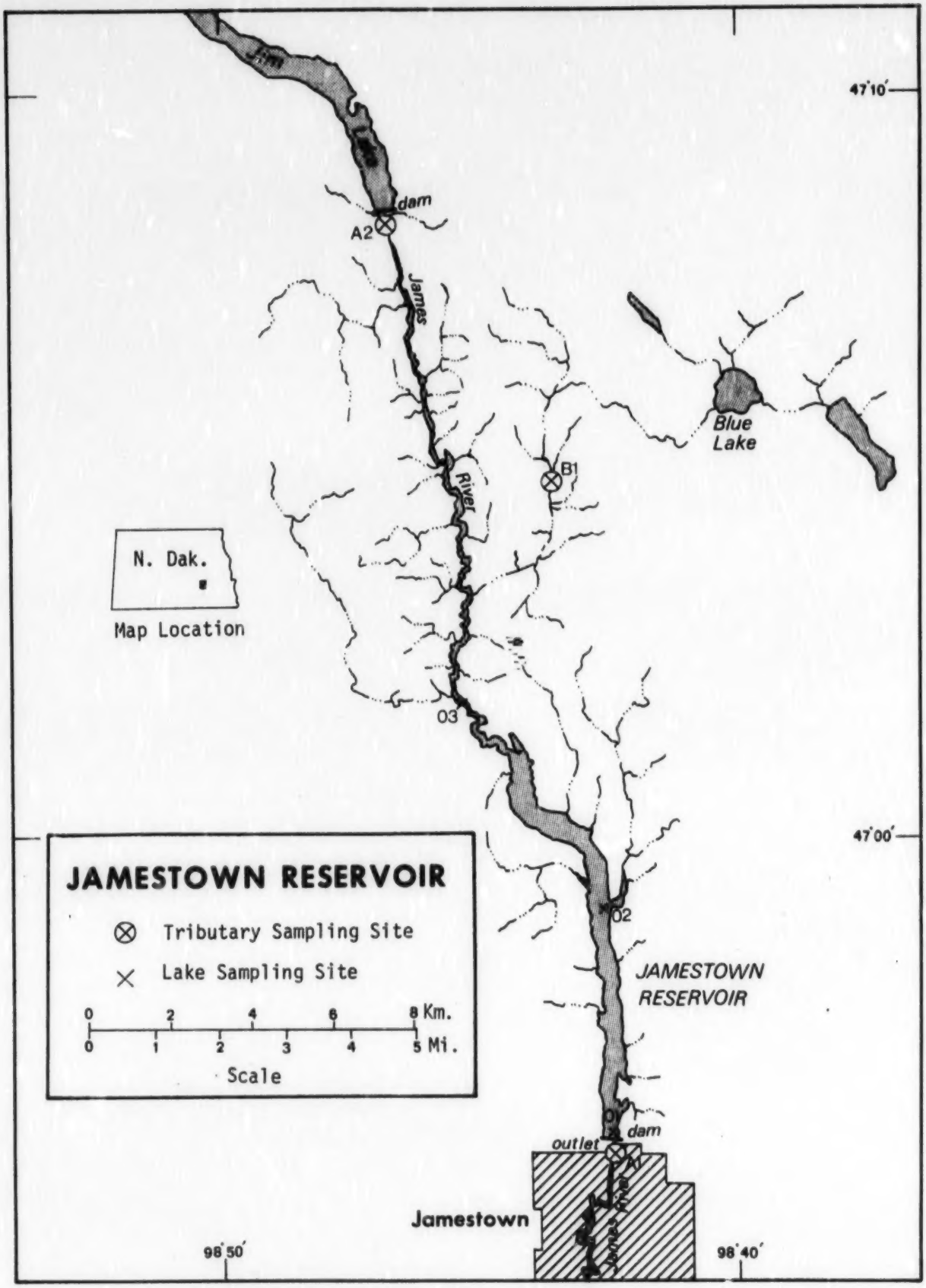
Major General LaClair A. Melhouse, the Adjutant General of North Dakota, and Project Officer Colonel Irvin M. Sande, who directed the volunteer efforts of the North Dakota National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES AND RESERVOIRS

STATE OF NORTH DAKOTA

NAME	COUNTY
Ashtabula	Barnes, Griggs
Audubon	McLean
Brush	McLean
Darling	Renville, Ward
Devils	Benson, Ramsey
Jamestown	Stutsman
LaMoure	LaMoure
Matejcek	Walsh
Metigoshe	Bottineau
Pelican	Bottineau
Sakakawea	Dunn, McKenzie, McLean, Mercer, Mountrail, Williams
Spiritwood	Stutsman
Sweet Briar	Morton
Whitman	Nelson, Walsh


47°10'
dam
A2
James
River
B1
Blue
Lake
N. Dak.
Map Location
03
47°00'
JAMESTOWN RESERVOIR
Tributary Sampling Site
Lake Sampling Site
0 2 4 6 8 Km.
0 1 2 3 4 5 Mi.
Scale
02
JAMESTOWN
RESERVOIR
01
dam
outlet
A1
Jamestown
98°50'
98°40'

JAMESTOWN RESERVOIR

STORET NO. 3806

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Jamestown Reservoir is eutrophic. It ranked seventh in overall trophic quality when the 14 North Dakota lakes and reservoirs sampled in 1974 were compared using a combination of six water quality parameters*. Six of the water bodies had less median total phosphorus and median dissolved orthophosphorus, 11 had less median inorganic nitrogen, five had less mean chlorophyll a, and five had greater mean Secchi disc transparency.

Survey limnologists observed algal blooms at station 2 in July and September, and submerged macrophytes and phytoplankton were noted at station 3 in July. Heavy algal blooms have been reported to occur (Peterson, 1975).

B. Rate-Limiting Nutrient:

The algal assay results indicate that Jamestown Reservoir was limited by nitrogen at the time the sample was collected (09/17/74). The reservoir data indicate phosphorus limitation at stations 1 and 2 in April but nitrogen limitation at all other sampling stations and times.

C. Nutrient Controllability:

1. Point sources--No known point sources impacted Jamestown

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* See Appendix A.

Reservoir within the 40-kilometer Survey limit* during the sampling year.

The present phosphorus loading of 0.92 g/m^2/year is over two times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading. Improvement in the trophic condition could result if it is possible to reduce the present incoming phosphorus load in the James River by 55%.

Further investigation is needed to determine the contribution and the controllability of nutrients from point sources further upstream at New Rockford and Carrigan as well as nutrients resulting from land-use practices in the drainage basin (Peterson, 1975).

2. Non-point sources--The James River contributed 90.7% of the total phosphorus load, and the ungaged minor tributaries and immediate drainage contributed an estimated 7.1%. However, part of the load in the James River probably was due to the point sources further upstream, although the relatively low export rate of the river (page 10) indicates the point sources may not be significant phosphorus contributors.

* See Working Paper No. 175, "...Survey Methods, 1973-1976".

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 4.86 kilometers^2.
2. Mean depth: 7.5 meters.
3. Maximum depth: 9.2 meters.
4. Volume: 36.670 x 10^6 m^3†††.
5. Mean hydraulic retention time: 1.6 years.

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
James River	1,776.7	0.541
Minor tributaries & immediate drainage -	160.9	0.199
Totals	1,937.6	0.740

2. Outlet -

James River	1,942.5**	0.710

C. Precipitation***:

1. Year of sampling: 60.7 centimeters.
2. Mean annual: 47.7 centimeters.

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† Table of metric conversions--Appendix B.
†† Henegar, 1975.
††† Anonymous, 1975.
* For limits of accuracy, see Working Paper No. 175.
** Includes area of reservoir.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Jamestown Reservoir was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two or more depths at three stations on the reservoir (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the September visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 9.1 meters at station 1, 7.6 meters at station 2, and 1.8 meters at station 3.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR JAMESTOWN RESERVOIR
STORET CODE 3606

PARAMETER	1ST SAMPLING (4/26/74) 3 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (7/17/74) 3 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (9/17/74) 3 SITES RANGE	MEAN	MEDIAN
TEMP (C)	4.9 - 12.5	6.9	5.9	23.9 - 25.7	24.8	24.7	14.1 - 14.9	14.6	14.7
DISS OXY (MG/L)	10.0 - 12.0	11.1	11.0	6.2 - 8.6	6.9	6.7	8.2 - 9.0	8.5	8.6
CNDCTVY (MCROMO)	417. - 445.	431.	427.	607. - 630.	619.	619.	484. - 492.	487.	485.
PH (STAND UNITS)	8.0 - 8.3	8.2	8.2	8.3 - 8.7	8.5	8.4	8.4 - 8.5	8.4	8.4
TOT ALK (MG/L)	154. - 240.	203.	213.	214. - 242.	227.	226.	240. - 266.	249.	245.
TOT P (MG/L)	0.111 - 0.271	0.151	0.123	0.213 - 0.262	0.235	0.232	0.107 - 0.163	0.125	0.118
ORTHO P (MG/L)	0.028 - 0.055	0.042	0.046	0.169 - 0.242	0.206	0.202	0.067 - 0.082	0.077	0.078
NO2+NO3 (MG/L)	0.080 - 0.850	0.615	0.670	0.020 - 0.340	0.247	0.295	0.020 - 0.080	0.039	0.030
AMMONIA (MG/L)	0.040 - 0.060	0.048	0.045	0.050 - 0.100	0.073	0.070	0.070 - 0.140	0.096	0.085
KJEL N (MG/L)	1.100 - 2.000	1.380	1.200	1.000 - 1.400	1.120	1.100	0.900 - 1.600	1.200	1.150
INORG N (MG/L)	0.120 - 0.900	0.663	0.710	0.070 - 0.410	0.320	0.380	0.090 - 0.220	0.135	0.115
TOTAL N (MG/L)	1.860 - 2.420	1.995	1.940	1.280 - 1.530	1.367	1.340	0.920 - 1.680	1.239	1.180
CHLRPYL A (UG/L)	6.4 - 32.7	19.5	19.4	4.6 - 74.2	28.4	6.3	2.3 - 22.1	10.3	6.6
SECCHI (METERS)	0.6 - 1.7	1.2	1.2	0.9 - 2.1	1.7	2.1	0.6 - 3.4	1.8	1.4

B. Biological Characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
04/26/74	1. *Cyclotella sp.*	7,179
	2. *Chroomonas sp.*	1,341
	3. *Ankistrodesmus sp.*	1,262
	4. *Scenedesmus sp.*	316
	5. *Crucigenia sp.*	237
	Other genera	2,287
	Total	12,622
07/17/74	1. *Melosira sp.*	4,335
	2. *Chroomonas sp.*	567
	3. *Schroederia sp.*	500
	4. *Chroococcus sp.*	133
	5. *Cryptomonas sp.*	133
	Other genera	568
	Total	6,236
09/17/74	1. *Cryptomonas sp.*	680
	2. *Crucigenia sp.*	486
	3. *Aphanizomenon sp.*	340
	4. Coccoid cells	291
	5. *Microcystis sp.*	146
	Other genera	1,067
	Total	3,010

2. Chlorophyll *a* -

Sampling Date	Station Number	Chlorophyll *a* (µg/l)
04/26/74	1	6.4
	2	19.4
	3	32.7
07/17/74	1	4.6
	2	6.3
	3	74.2
09/17/74	1	2.3
	2	6.6
	3	22.1

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.085	0.149	4.4
0.050 P	0.135	0.149	4.3
0.050 P + 1.0 N	0.135	1.149	25.8
1.0 N	0.085	1.149	25.3

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Jamestown Reservoir was rather high at the time the sample was collected (09/17/74). Also, the lack of increased yield with the addition of phosphorus until nitrogen was also added indicates that the reservoir was nitrogen limited at that time. Note that the addition of nitrogen alone resulted in a yield far greater than that of the control.

The April reservoir data indicate phosphorus limitation at station 1 and 2 but nitrogen limitation at station 3; i.e., the mean inorganic nitrogen/orthophosphorus ratios were 19/1, 24/1, and 2/1, respectively. Nitrogen limitation is indicated in July and September (the mean N/P ratios were 3/1 or less at all sampling stations, and nitrogen limitation would be expected).

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the North Dakota National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff month of May when two samples were collected. Sampling was begun in September, 1974, and was completed in August, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the North Dakota District Office of the U.S. Geological Survey for the tributary sites nearest the reservoir.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the nutrient loads at station A-2, in $kg/km^2/year$, and multiplying by the ZZ area in km^2.

No known wastewater treatment facilities within the 40-kilometer Survey limit* discharged to Jamestown Reservoir or its tributaries during the sampling year.

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* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal - None within the Survey limit.

2. Known industrial - None.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
James River	4,070	90.7
b. Minor tributaries & immediate drainage (non-point load) -	320	7.1
c. Known municipal STP's - None	-	-
d. Septic tanks* -	15	0.3
e. Known industrial - None	-	-
f. Direct precipitation** -	85	1.9
Total	4,490	100.0

2. Outputs -

Lake outlet - James River 4,570

3. Net annual P loss - 80 kg.

* Estimate based on 60 lakeshore dwellings; see Working Paper No. 175.
** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
James River	40,885	81.0
b. Minor tributaries & immediate drainage (non-point load) -	3,700	7.3
c. Known municipal STP's - None	-	-
d. Septic tanks* -	640	1.3
e. Known industrial - None	-	-
f. Direct precipitation** -	5,245	10.4
Total	50,470	100.0

2. Outputs -

Lake outlet - James River 34,875

3. Net annual N accumulation - 15,595 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km²/yr	kg N/km²/yr
James River	2	23

E. Mean Nutrient Concentrations in Ungaged Stream:

Tributary	Mean Total P Conc. (mg/l)	Mean Total N Conc. (mg/l)
Unnamed Creek B-1	0.231	2.455

* Estimate based on 60 lakeshore dwellings; see Working Paper No. 175.
** See Working Paper No. 175.

F. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	0.92	loss*	10.4	3.2

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Jamestown Reservoir:

"Dangerous" (eutrophic loading)	0.42
"Permissible" (oligotrophic loading)	0.21

* There was an apparent phosphorus loss during the sampling year. This may have been due to the unmeasured contributions of the intermittent tributaries of the reservoir.

V. LITERATURE REVIEWED

Anonymous, 1975. Water resources data for North Dakota. Part 1: Surface water records. U.S. Geol. Surv., Bismarck.

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Peterson, Norman L., 1974. Personal communication (point sources affecting Jamestown Reservoir). ND Dept. of Health, Bismarck.

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VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
3801	LAKE ASHTABULA	0.260	0.160	472.250	40.892	10.600	0.170
3802	LAKE AUDUBON	0.067	0.220	446.222	11.322	11.000	0.015
3803	BRUSH LAKE	0.066	0.095	449.143	29.114	9.000	0.010
3804	LAKE DARLING	0.274	0.250	466.750	60.075	11.500	0.180
3805	DEVILS LAKE	0.630	0.140	449.333	38.508	14.600	0.469
3806	JAMESTOWN RESERVOIR	0.144	0.365	438.667	19.400	8.800	0.078
3807	LAKE LA MOURE	0.438	0.380	421.400	19.720	15.000	0.290
3808	MATEJCEK LAKE	0.228	0.440	475.167	2.683	14.400	0.179
3809	LAKE METIGOSHE	0.032	0.080	389.167	10.367	9.000	0.010
3811	PELICAN LAKE	0.034	0.070	364.500	10.950	12.800	0.006
3812	LAKE SAKAKAWEA (GARRISON	0.016	0.150	408.733	6.883	10.800	0.007
3813	SPIRIT WOOD LAKE	0.156	0.290	417.833	34.667	15.000	0.082
3814	SWEET BRIAR RESERVOIR	0.092	0.090	440.800	39.000	8.800	0.031
3815	WHITMAN LAKE	0.260	0.260	478.333	27.067	9.200	0.185

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	SEC MEAN	CHLOR A	IS-MIN OD	MEDIAN DISS ORTHO P	INDEX NO
3801	LAKE ASHTABULA	27 (3)	54 (7)	15 (2)	8 (1)	62 (8)	38 (5)	204
3802	LAKE AUDUBON	69 (9)	46 (6)	46 (6)	69 (9)	46 (6)	69 (9)	345
3803	BRUSH LAKE	77 (10)	77 (10)	38 (5)	38 (5)	81 (10)	81 (10)	392
3804	LAKE DARLING	15 (2)	38 (5)	23 (3)	0 (0)	38 (5)	23 (3)	137
3805	DEVILS LAKE	0 (0)	69 (9)	31 (4)	23 (3)	15 (2)	0 (0)	138
3806	JAMESTOWN RESERVOIR	54 (7)	15 (2)	62 (8)	62 (8)	96 (12)	54 (7)	343
3807	LAKE LA MOURE	8 (1)	8 (1)	69 (9)	54 (7)	4 (0)	8 (1)	151
3808	MATEJCEK LAKE	38 (5)	0 (0)	8 (1)	100 (13)	23 (3)	31 (4)	200
3809	LAKE METIGOSHE	92 (12)	92 (12)	92 (12)	85 (11)	81 (10)	81 (10)	523
3811	PELICAN LAKE	85 (11)	100 (13)	100 (13)	77 (10)	31 (4)	100 (13)	493
3812	LAKE SAKAKAWEA (GARRISON	100 (13)	62 (8)	85 (11)	92 (12)	54 (7)	92 (12)	485
3813	SPIRIT WOOD LAKE	46 (6)	23 (3)	77 (10)	31 (4)	4 (0)	46 (6)	227
3814	SWEET BRIAR RESERVOIR	62 (8)	85 (11)	54 (7)	15 (2)	96 (12)	62 (8)	374
3815	WHITMAN LAKE	27 (3)	31 (4)	0 (0)	46 (6)	69 (9)	15 (2)	188

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	3809	LAKE METIGOSHE	523
2	3811	PELICAN LAKE	493
3	3812	LAKE SAKAKAWEA (GARRISON	485
4	3803	BRUSH LAKE	392
5	3814	SWEET BRIAR RESERVOIR	374
6	3802	LAKE AUDUBON	345
7	3806	JAMESTOWN RESERVOIR	343
8	3813	SPIRIT WOOD LAKE	227
9	3801	LAKE ASHTABULA	204
10	3808	MATEJCEK LAKE	200
11	3815	WHITMAN LAKE	188
12	3807	LAKE LA MOURE	151
13	3805	DEVILS LAKE	138
14	3804	LAKE DARLING	137

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CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR NORTH DAKOTA 03/16/76

LAKE CODE 3806 JAMESTOWN RESERVOIR

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 1942.5

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
3806A1	1942.5	0.15	0.16	0.88	1.59	1.33	1.56	1.10	0.48	0.45	0.40	0.22	0.21	0.71
3806A2	1776.7	0.028	0.011	0.934	2.379	1.161	0.651	0.261	0.283	0.204	0.311	0.164	0.096	0.541
3806ZZ	165.8	0.042	0.045	0.246	0.453	0.368	0.425	0.311	0.136	0.127	0.110	0.062	0.057	0.199

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 1942.5
SUM OF SUB-DRAINAGE AREAS = 1942.5
TOTAL FLOW IN = 8.67
TOTAL FLOW OUT = 8.52

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3806A1	9	74	1.303	21	1.274				
	10	74	0.680	20	0.0				
	11	74	0.0	16	0.0				
	12	74	0.0	22	0.0				
	1	75	0.0	18	0.0				
	2	75	0.0						
	3	75	0.0	22	0.0				
	4	75	1.161	5	0.0	20	0.0		
	5	75	9.911	4	9.911	17	9.911		
	6	75	6.938	23	1.416				
	7	75	3.653	19	5.663				
	8	75	7.079	22	7.079				
3806A2	9	74	0.821	21	0.934				
	10	74	0.136	20	0.000				
	11	74	0.000	16	0.000				
	12	74	0.0	22	0.0				
	1	75	0.0	18	0.0				
	2	75	0.0						
	3	75	0.0	22	0.0				
	4	75	5.550	5	0.0	20	2.832		
	5	75	11.978	4	21.238	17	9.911		
	6	75	2.662	22	1.699				
	7	75	1.019	19	0.680				
	8	75	0.127	22	0.057				
3806ZZ	9	74	0.071						
	10	74	0.011						
	11	74	0.0						
	12	74	0.0						
	1	75	0.0						
	2	75	0.0						
	3	75	0.0						
	4	75	0.510						
	5	75	1.133						
	6	75	0.255						
	7	75	0.099						
	8	75	0.011						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/03/16

380601
46 55 54.0 098 42 24.0 3
JAMESTOWN RESERVOIR
38093 NORTH DAKOTA

11EPALES 2111202
0035 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/26	13 30	0000	5.1		66	445	8.10	240	0.060	1.600	0.820	0.045
	13 30	0005	4.9	10.8		445	8.10	216	0.060	1.200	0.840	0.048
	13 30	0015	4.9	11.0		445	8.00	220	0.050	1.200	0.850	0.048
	13 30	0030	4.9	10.0		444	8.00	224	0.060	1.100	0.840	0.050
74/07/17	15 00	0000	24.9	6.6	84	625	8.50	224	0.080	1.200	0.330	0.199
	15 00	0005	24.8	6.4		625	8.40	230	0.070	1.100	0.330	0.202
	15 00	0017	24.7	6.8		620	8.40	222	0.070	1.000	0.340	0.198
	15 00	0030	24.5	6.6		618	8.60	232	0.060	1.000	0.310	0.198
74/09/17	10 00	0000	14.9	8.6	132	484	8.42	240	0.080	1.200	0.030	0.075
	10 00	0009	14.9			485	8.45	240	0.070	0.900	0.020	0.079
	10 00	0018	14.9	8.6		484	8.45	244	0.070	0.900	0.020	0.082

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/26	13 30	0000	0.113	6.4	
	13 30	0005	0.111		
	13 30	0015	0.129		
	13 30	0030	0.134		
74/07/17	15 00	0000	0.224	4.6	
	15 00	0005	0.230		
	15 00	0017	0.213		1.0
	15 00	0030	0.218		
74/09/17	10 00	0000	0.108	2.3	
	10 00	0009	0.107		
	10 00	0018	0.112		

STORET RETRIEVAL DATE 76/03/16

380602
46 55 56.0 098 42 28.0 3
JAMESTOWN RESERVOIR
38043 NORTH DAKOTA

11EPALES 2111202
0027 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/26	14 25	0000	6.2		48	420	8.20	210	0.040	1.300	0.640	0.030
	14 25	0005	6.1	11.4		420	8.20	206	0.040	1.200	0.660	0.029
	14 25	0015	6.1	11.4		419	8.20	190	0.040	1.200	0.670	0.028
	14 25	0023	5.8	12.0		417	8.20	218	0.040	1.200	0.670	0.029
74/07/17	14 40	0000	25.4	7.2	84	630	8.50	214	0.070	1.100	0.230	0.202
	14 40	0005	24.6	6.8		622	8.40	232	0.100	1.000	0.290	0.210
	14 40	0015	24.0	6.4		610	8.40	222	0.080	1.000	0.280	0.229
	14 40	0025	23.9	6.2		607	8.30	226	0.090	1.100	0.300	0.242
74/09/17	10 25	0000	14.9	9.0	54	489	8.47	244	0.080	1.300	0.030	0.079
	10 25	0015	14.5	8.4		485	8.48	248	0.090	1.100	0.030	0.082
	10 25	0021	14.4	8.2		485	8.47	246	0.100	1.000	0.030	0.078

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/26	14 25	0000	0.126	19.4	
	14 25	0005	0.120		
	14 25	0015	0.120		
	14 25	0023	0.117	6.3	
74/07/17	14 40	0000	0.231		1.0
	14 40	0005	0.234		
	14 40	0013			
	14 40	0015	0.248		
	14 40	0025	0.244	6.6	
74/09/17	10 25	0000	0.117		
	10 25	0015	0.120		
	10 25	0021	0.121		

STORET RETRIEVAL DATE 76/03/16

380603
47 01 53.0 098 45 14.0 3
JAMESTOWN RESERVOIR
380?3 NORTH DAKOTA

11EPALES 2111202
0005 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/26	14 05	0000	12.5		24	427	8.35	154	0.040	2.000	0.080	0.055
	14 05	0002	12.5	11.0		427	8.30	154	0.050	1.800	0.080	0.055
74/07/17	14 20	0000	25.7	8.6	36	616	8.70	242	0.050	1.400	0.020	0.210
	14 20	0006	25.1	7.8		613	8.70	226	0.060	1.300	0.040	0.169
74/09/17	10 45	0000	14.1	8.6	24	492	8.39	266	0.140	1.600	0.070	0.067
	10 45	0005	14.1	8.4		491	8.41	266	0.140	1.600	0.080	0.072

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/26	14 05	0000	0.271	32.7	
	14 05	0002	0.270		
74/07/17	14 20	0000	0.262	74.2	
	14 20	0006	0.246		1.0
74/09/17	10 45	0000	0.154	22.1	
	10 45	0005	0.163		

APPENDIX E

TRIBUTARY DATA

STORET RETRIEVAL DATE 76/03/18

380641
46 55 52.0 098 42 29.0 4
JAMES RIVER
38071 7.5 JAMESTOWN
U/JAMESTOWN RESERVOIR
BELOW JAMESTOWN DAM AT E OUTLET
11EPALES 2111204
0000 FEET DEPTH CLASS 00

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DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/09/21	13 45		0.012	1.200	0.035	0.100	0.125
75/05/04	11 50		0.230	2.200	0.135	0.090	0.100
75/05/17	09 30		0.290	1.700	0.230	0.100	0.130
75/06/23	10 05		0.185	1.200	0.143	0.158	0.190
75/07/19	11 35		0.125	0.750	0.020	0.240	0.240
75/08/22	08 30		0.125	1.000	0.030	0.180	0.250

STORET RETRIEVAL DATE 76/03/18

3R06A2
47 08 20.0 098 46 40.0 4
JAMES RIVER
38 7.5 JIM LAKE
T/JAMESTOWN RESERVOIR
CULVERT BELOW JIM LAKE DAM
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/09/21	15	30	0.008	2.600	0.020	0.075	0.195
75/05/04	11	00	0.007	1.900	0.030	0.040	0.140
75/05/17	11	00	0.460	2.700	0.120	0.080	0.230
75/06/22	08	30	0.050	1.900	0.155	0.145	0.270
75/07/19	09	30	0.010	4.100	0.065	0.145	0.330
75/08/22	11	10	0.025	2.750	0.080	0.160	0.345

STORET RETRIEVAL DATE 76/03/18

380681
47 04 51.0 098 43 30.0 4
UNNAMED CREEK
38 7.5 FRIED
T/JAMESTOWN RESERVOIR
BRDG ON GRAVEL RD 5.6 MI NW OF FRIED
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/09/21	15 00		0.028	1.800	0.025	0.095	0.155
75/04/20	09 30		0.660	2.700	0.570	0.155	0.280
75/05/04	10 25		0.390	2.400	0.045	0.070	0.180
75/05/17	10 30		0.005	1.450	0.016	0.022	0.110
75/06/22	09 00		0.025	2.900	0.165	0.145	0.300
75/07/19	10 00		0.005	2.100	0.045	0.140	0.280
75/08/22	10 20		0.020	2.700	0.100	0.120	0.310